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# BB403M

Build in Biasing Circuit MOS FET IC  
VHF/UHF RF Amplifier

# HITACHI

ADE-208-699A (Z)  
2nd. Edition  
Nov. 1998

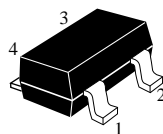
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## Features

- Build in Biasing Circuit; To reduce using parts cost & PC board space.
- High forward transfer admittance;  
( $|y_{fs}| = 42 \text{ mS typ. at } f = 1 \text{ kHz}$ )
- Withstanding to ESD;  
Build in ESD absorbing diode. Withstand up to 250V at  $C=200\text{pF}$ ,  $R_s=0$  conditions.
- Provide mini mold packages; MPAK-4R (SOT-143 var.)

## Outline

MPAK-4R



1. Source
2. Drain
3. Gate2
4. Gate1

Notes: 1. Marking is "CX-".

2. BB403M is individual type number of HITACHI BBFET.

## BB403M

### Absolute Maximum Ratings (Ta = 25°C)

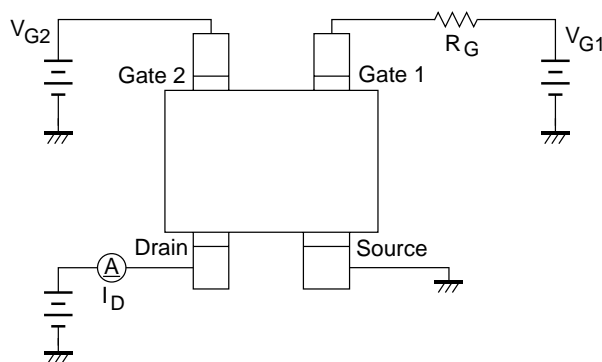
Item	Symbol	Ratings	Unit
Drain to source voltage	$V_{DS}$	7	V
Gate1 to source voltage	$V_{G1S}$	− 0/ +7	V
Gate2 to source voltage	$V_{G2S}$	− 0/ +7	V
Drain current	$I_D$	25	mA
Channel power dissipation	Pch	150	mW
Channel temperature	Tch	150	°C
Storage temperature	Tstg	−55 to +150	°C

### Electrical Characteristics (Ta = 25°C)

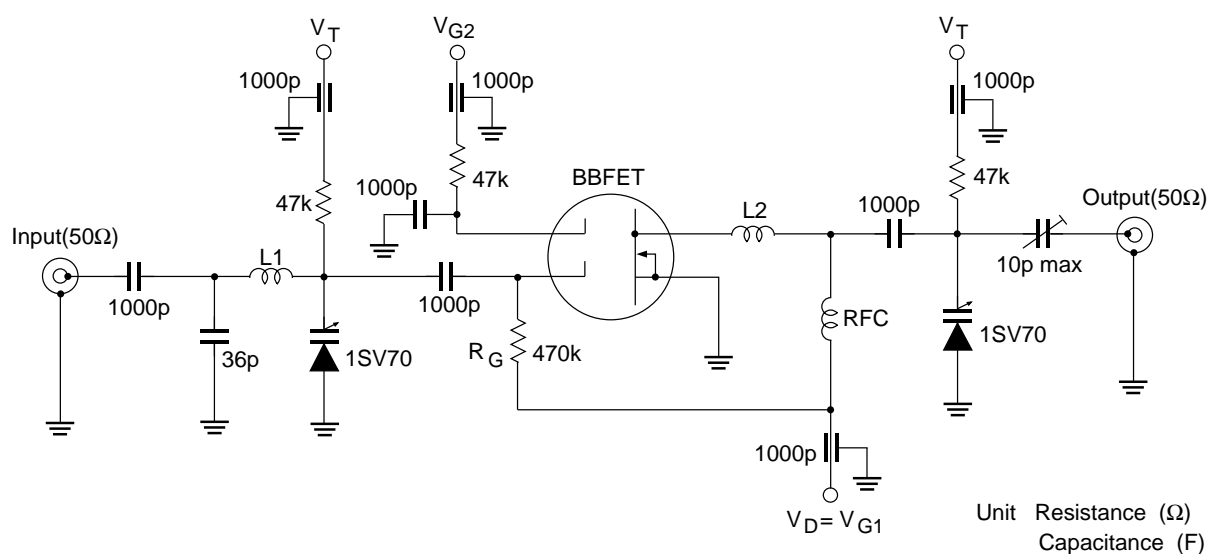
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	7	—	—	V	$I_D = 200\mu A$ $V_{G1S} = V_{G2S} = 0$
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+7	—	—	V	$I_{G1} = +10\mu A$ $V_{G2S} = V_{DS} = 0$
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	+7	—	—	V	$I_{G2} = +10\mu A$ $V_{G1S} = V_{DS} = 0$
Gate1 to source cutoff current	$I_{G1SS}$	—	—	+100	nA	$V_{G1S} = +5V$ $V_{G2S} = V_{DS} = 0$
Gate2 to source cutoff current	$I_{G2SS}$	—	—	+100	nA	$V_{G2S} = +5V$ $V_{G1S} = V_{DS} = 0$
Gate1 to source cutoff voltage	$V_{G1S(off)}$	0.3	0.6	0.9	V	$V_{DS} = 5V, V_{G2S} = 4V$ $I_D = 100\mu A$
Gate2 to source cutoff voltage	$V_{G2S(off)}$	0.5	0.8	1.1	V	$V_{DS} = 5V, V_{G1S} = 5V$ $I_D = 100\mu A$
Drain current	$I_{D(op)}$	9	14	20	mA	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V, R_G = 470k\Omega$
Forward transfer admittance	$ y_{fs} $	35	42	50	mS	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V$ $R_G = 470k\Omega, f = 1kHz$
Input capacitance	$C_{iss}$	2.6	3.3	4.0	pF	$V_{DS} = 5V, V_{G1} = 5V$
Output capacitance	$C_{oss}$	1.7	2.1	2.5	pF	$V_{G2S} = 4V, R_G = 470k\Omega$
Reverse transfer capacitance	$C_{rss}$	—	0.025	0.05	pF	$f = 1MHz$
Power gain	PG1	28	32	—	dB	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V, R_G = 470k\Omega$
Noise figure	NF1	—	1.0	1.6	dB	$f = 200MHz$
Power gain	PG2	12	16.5	—	dB	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V, R_G = 470k\Omega$
Noise figure	NF2	—	2.85	3.7	dB	$f = 900MHz$

## Main Characteristics

Test Circuit for Operating Items ( $I_{D(op)}$ ,  $|y_{fs}|$ ,  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$ , NF, PG)

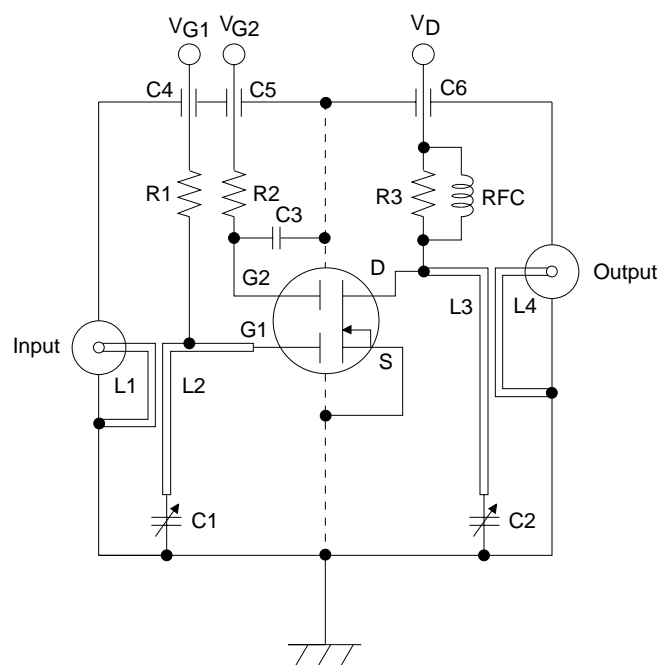


Power Gain, Noise Figure Test Circuit



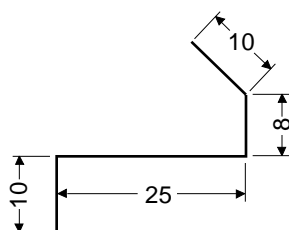
L1 :  $\phi 1\text{mm}$  Enameled Copper Wire, Inside dia 10mm, 2Turns  
L2 :  $\phi 1\text{mm}$  Enameled Copper Wire, Inside dia 10mm, 2Turns  
RFC :  $\phi 1\text{mm}$  Enameled Copper Wire, Inside dia 5mm, 2Turns

## 900MHz Power Gain, Noise Test Circuit

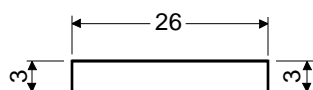


- C1, C2 : Variable Capacitor (10pF MAX)  
 C3 : Disk Capacitor (1000pF)  
 C4 to C6 : Air Capacitor (1000pF)  
 R1 : 470 k $\Omega$   
 R2 : 47 k $\Omega$   
 R3 : 4.7 k $\Omega$

L1:

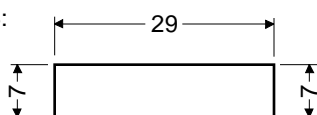


L2:

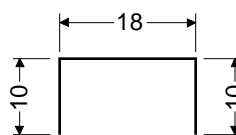


( $\phi$ 1mm Copper wire)  
 Unit : mm

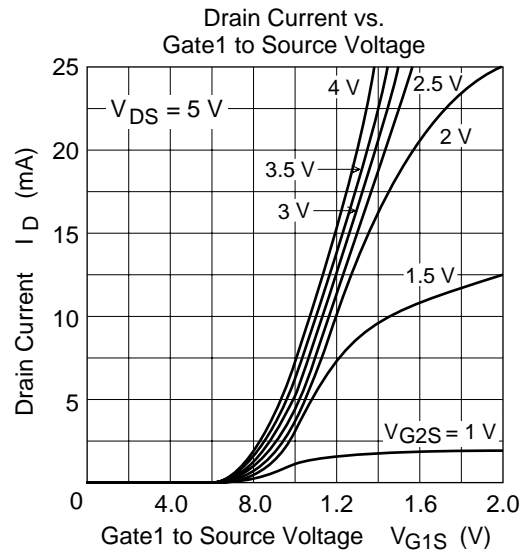
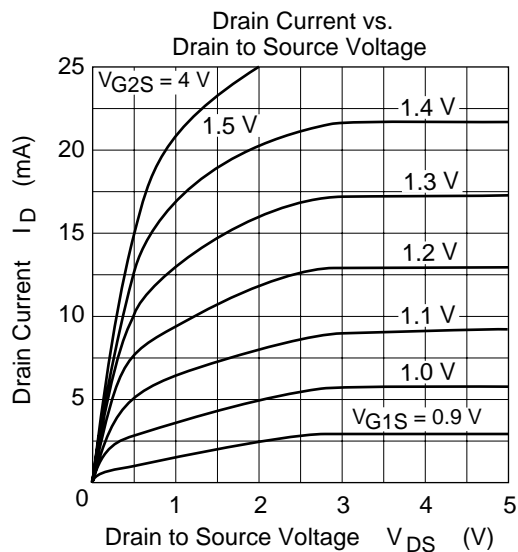
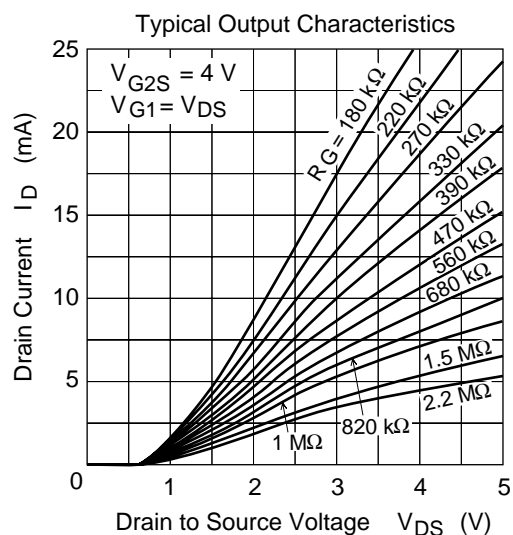
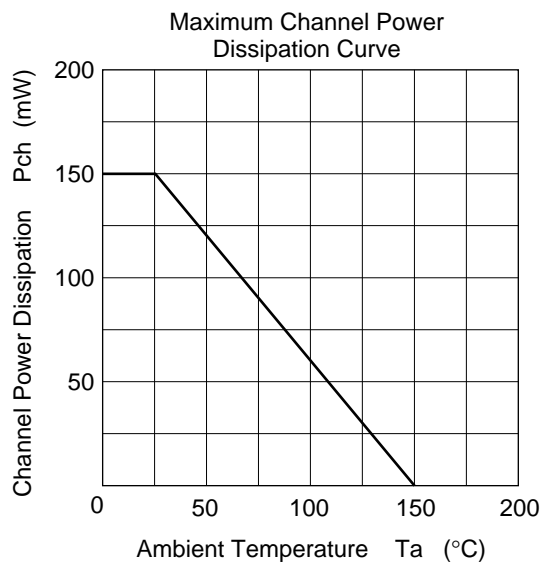
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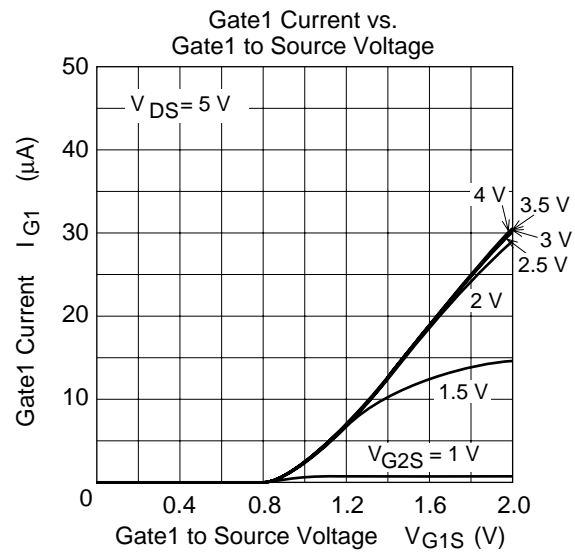
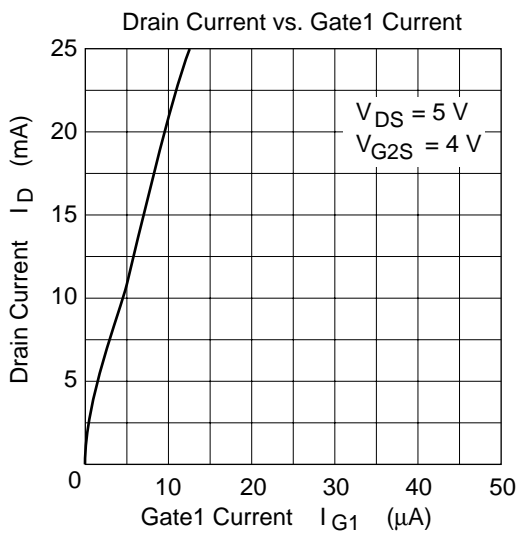
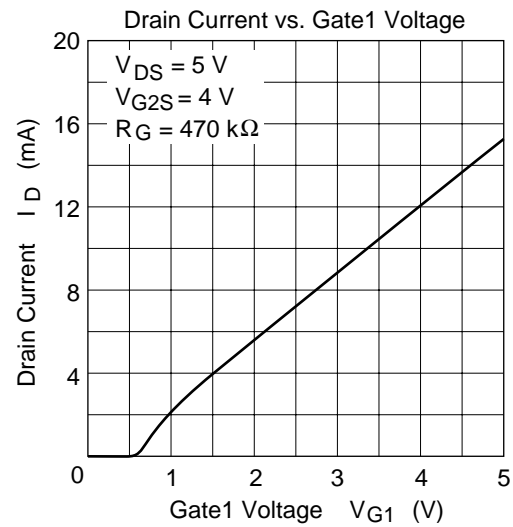
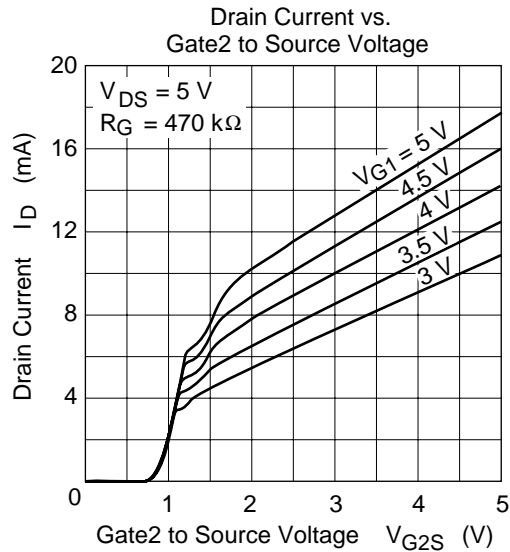


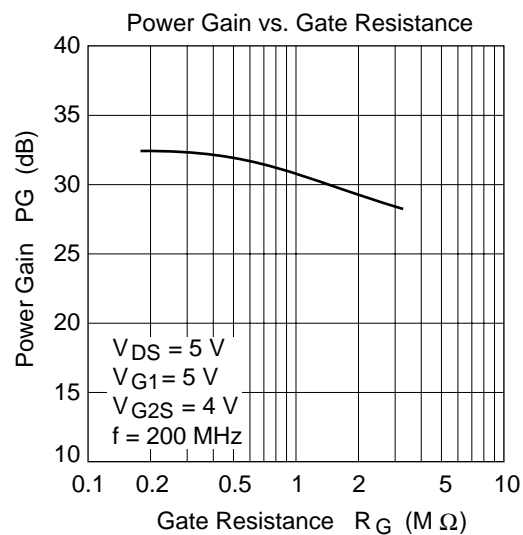
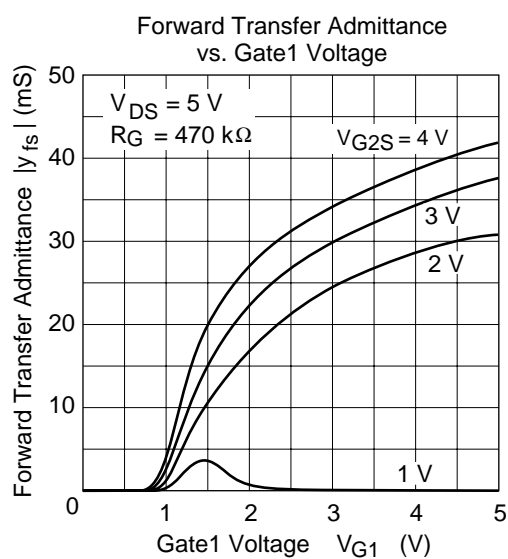
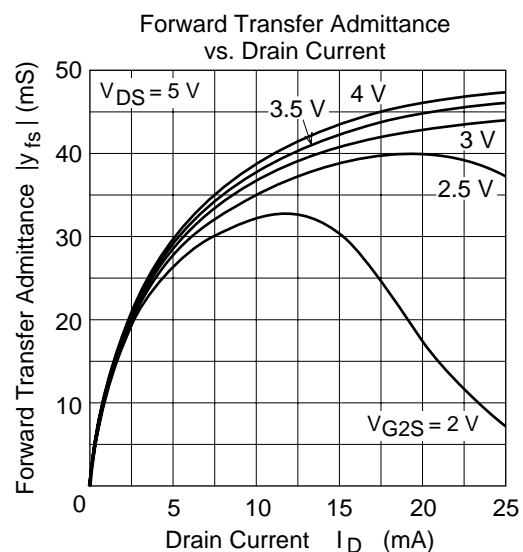
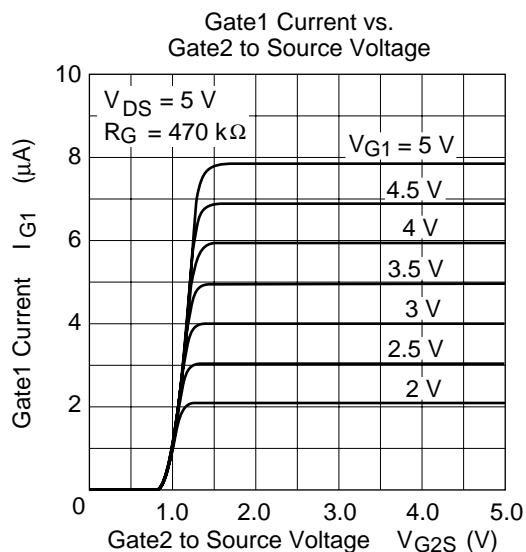
L4:

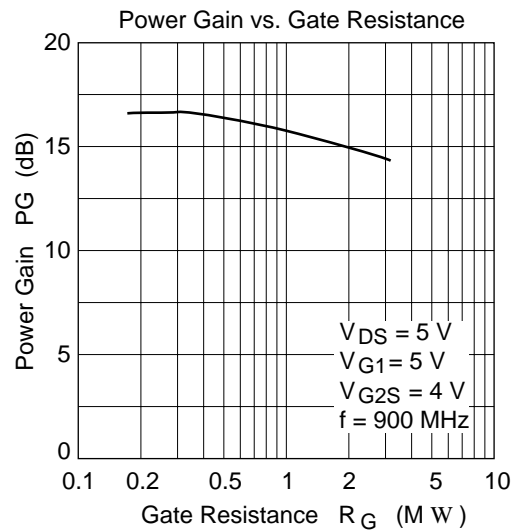
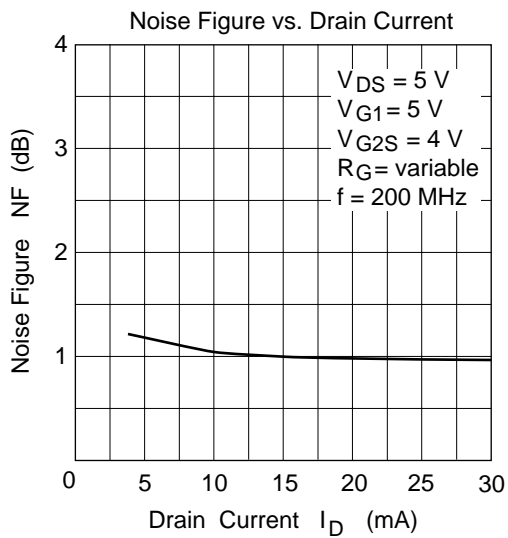
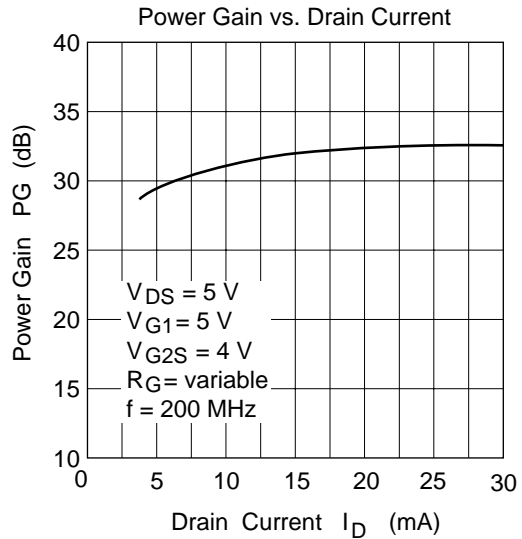
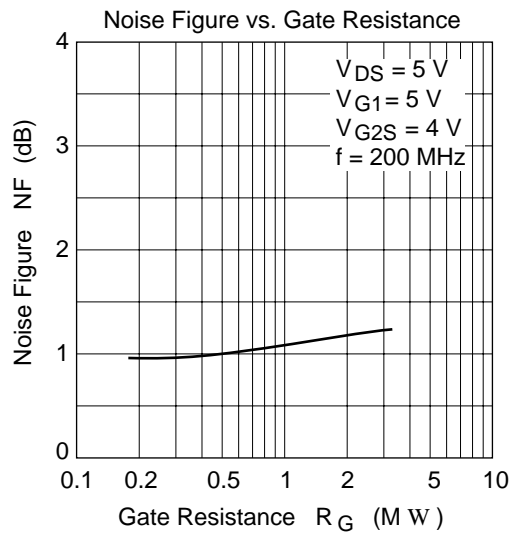


RFC :  $\phi$ 1mm Copper wire with enamel 4turns inside dia 6mm

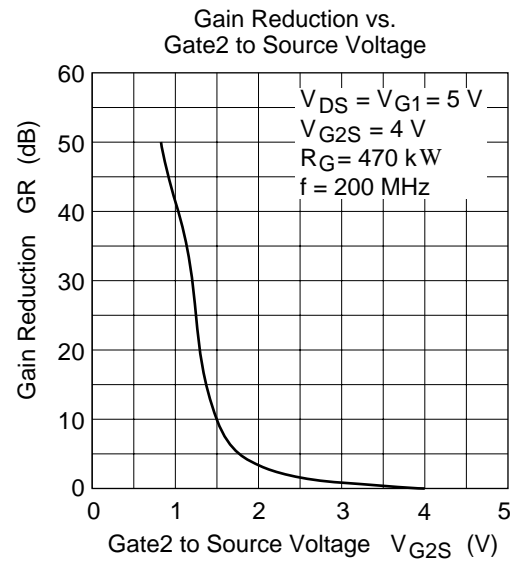
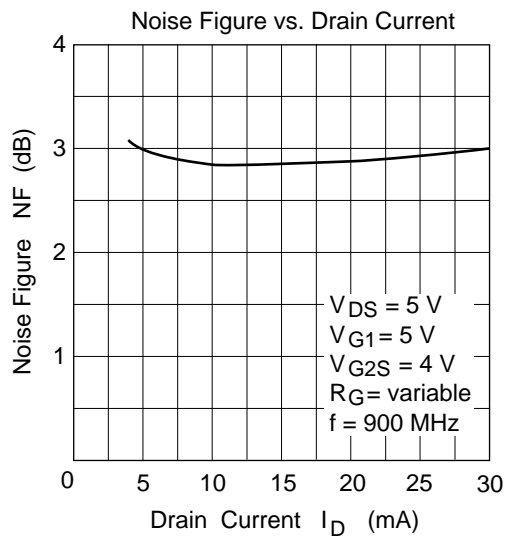
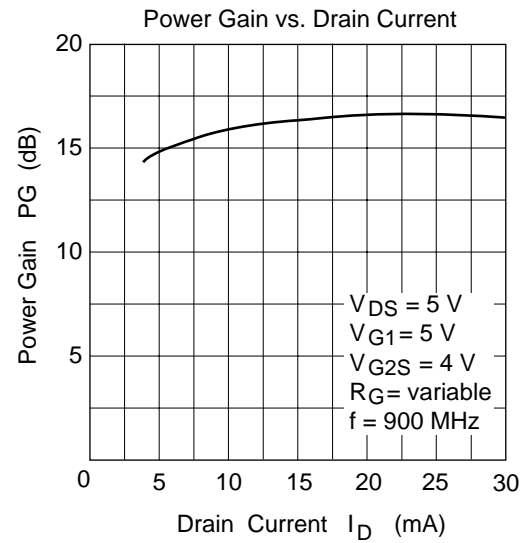
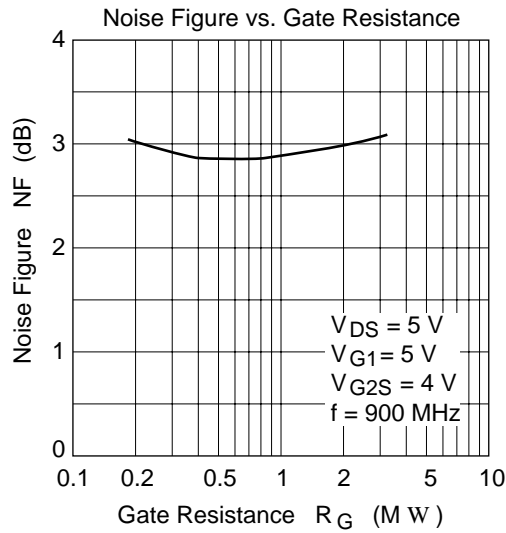


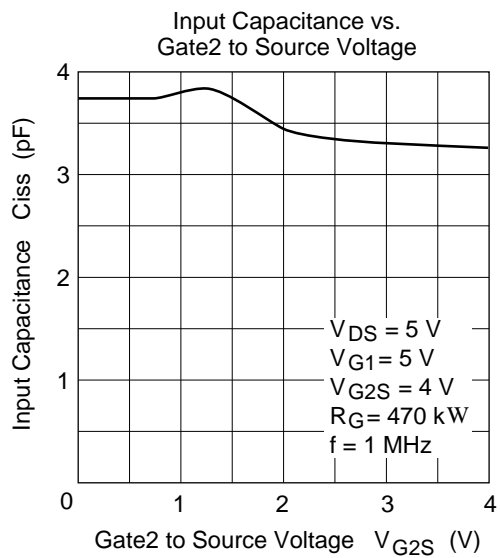
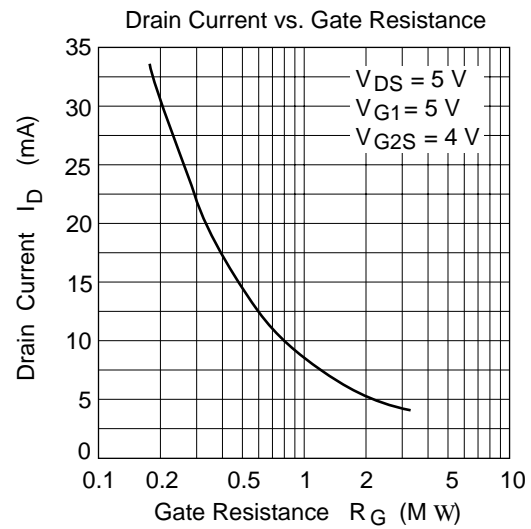
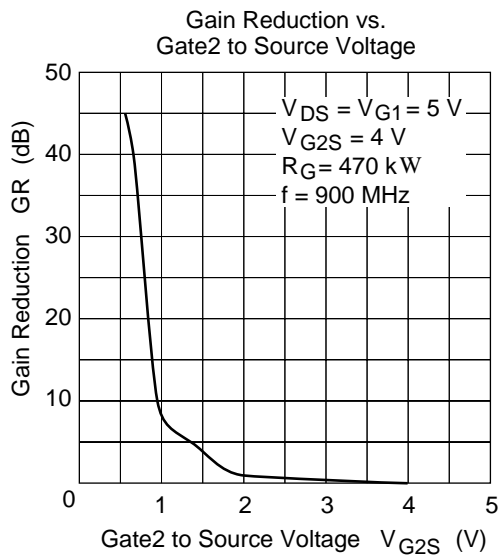


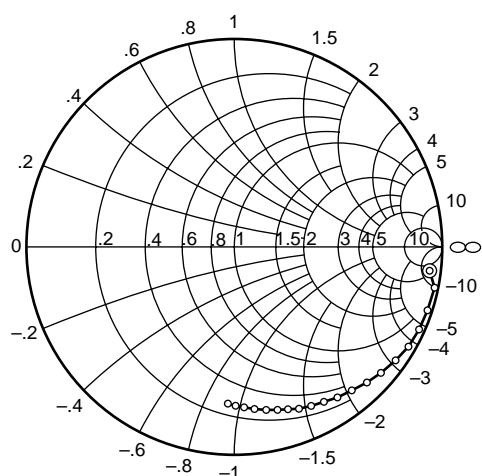




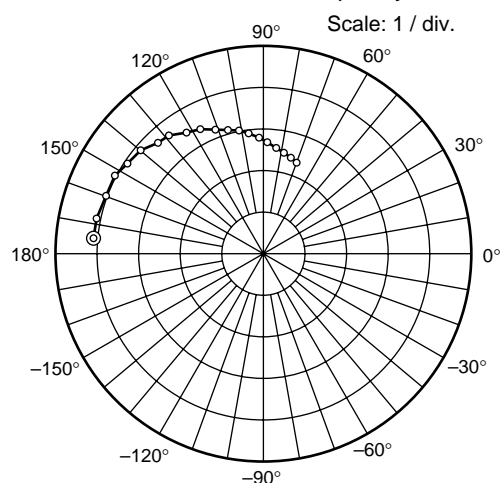




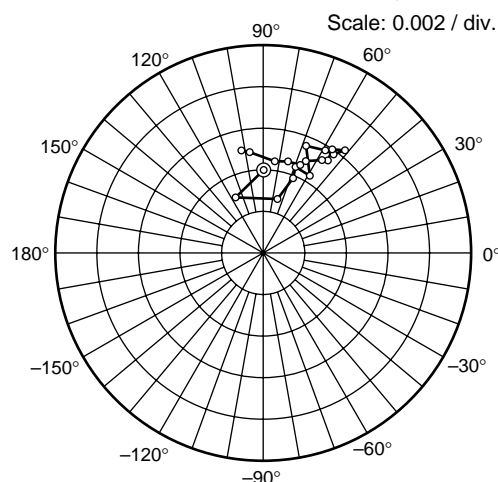


**S11 Parameter vs. Frequency**


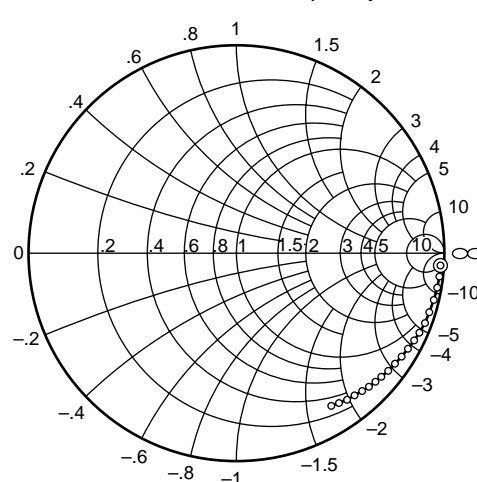
Test Condition :  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 $Z_0 = 50\ \Omega$   
 50 to 1000 MHz (50 MHz step)


**S21 Parameter vs. Frequency**


Test Condition :  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 $Z_0 = 50\ \Omega$   
 50 to 1000 MHz (50 MHz step)


**S12 Parameter vs. Frequency**


Test Condition :  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 $Z_0 = 50\ \Omega$   
 50 to 1000 MHz (50 MHz step)


**S22 Parameter vs. Frequency**


Test Condition :  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 $Z_0 = 50\ \Omega$   
 50 to 1000 MHz (50 MHz step)



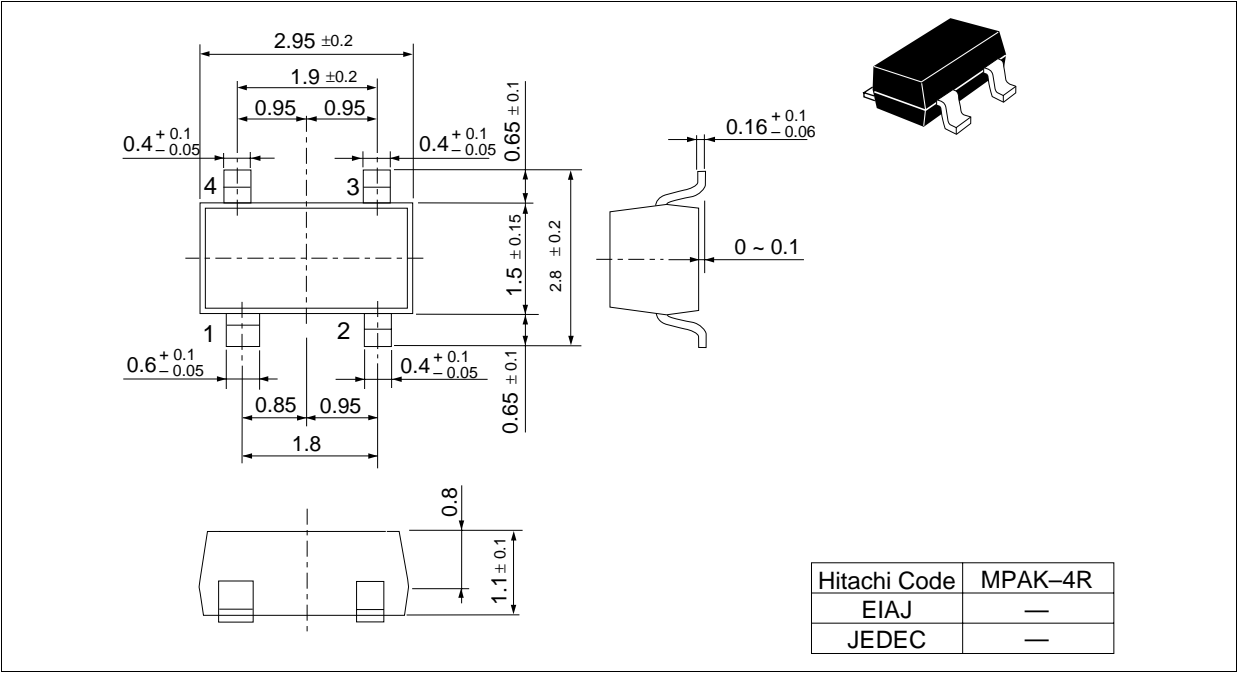
## BB403M

**Sparameter** ( $V_{DS} = V_{G1} = 5V$ ,  $V_{G2S} = 4V$ ,  $R_G = 470k\Omega$ ,  $Z_O = 50\Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
50	0.947	-7.0	4.11	174.4	0.00400	89.0	0.985	-3.1
100	0.978	-11.9	4.13	167.1	0.00305	116.5	0.985	-6.8
150	0.973	-18.7	4.04	159.8	0.00266	75.5	0.982	-10.1
200	0.960	-23.8	4.01	152.7	0.00384	66.8	0.978	-13.5
250	0.956	-29.6	3.90	146.4	0.00453	70.1	0.970	-16.8
300	0.939	-35.5	3.85	139.9	0.00440	59.6	0.965	-20.0
350	0.930	-40.3	3.68	133.6	0.00550	67.2	0.957	-23.1
400	0.905	-45.7	3.63	128.3	0.00571	59.0	0.949	-26.2
450	0.889	-50.3	3.45	122.7	0.00583	54.2	0.940	-29.2
500	0.870	-55.6	3.35	116.6	0.00634	51.6	0.932	-32.1
550	0.855	-59.6	3.22	111.5	0.00596	56.2	0.924	-35.0
600	0.841	-63.9	3.10	106.3	0.00591	55.7	0.917	-37.7
650	0.826	-67.9	3.02	101.4	0.00544	54.9	0.908	-40.5
700	0.812	-71.8	2.89	96.1	0.00533	57.2	0.900	-43.1
750	0.799	-75.6	2.78	91.8	0.00495	64.6	0.893	-45.7
800	0.788	-78.9	2.70	87.5	0.00470	66.5	0.887	-48.1
850	0.778	-82.6	2.60	82.2	0.00460	75.1	0.880	-50.6
900	0.765	-85.8	2.48	78.1	0.00445	83.8	0.874	-52.9
950	0.763	-88.8	2.41	74.2	0.00486	97.0	0.869	-55.3
1000	0.748	-92.2	2.34	69.7	0.00502	102.6	0.864	-57.5

Package Dimensions

Unit: mm



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